Compliance Using Ducts Buried in Attic Insulation

Note: This material is entirely new and shown without underlines for clarity. It will be included in ACM Chapter 4 and Appendix RF.

1. **Design.**
   A. The Duct system shall be designed in accordance with ACM 4.7.4 using a method such as ACCA Manual D. A design and layout must be developed that shows duct length, size, duct R-value, attic R-value, and the degree of burial of each individual trunk and branch.

2. **Minimum Value.**
   A. R-4.2 or greater insulated ductwork must be used even in those portions of the system that are buried.

3. **Calculation.**
   A. For the purposes of calculating Effective System R-value, four levels of burial are recognized:
   Unburied. An Unburied duct shall be recognized as having only it's rated R-value. Under no circumstances should any provision of this standard be construed as approving ductwork with a rating of less than R-4.2 (See Attachment #1 for an illustration of burial levels)
   Partially Buried. A partially buried duct is defined as a duct where at least 75% of the diameter of the duct is below the surface of the insulation. That portion of the ductwork which is covered to some degree by insulation, but not to a depth that meets the definition of partially buried, shall be considered unburied for the purposes of calculating the Effective System R-value. Partially buried ductwork shall be considered to have a value of **R-9** for both fiberglass and cellulose insulation.
   Fully Buried. A duct shall be classified as Fully Buried when the top surface of the duct is at or below the surface of the attic insulation. That portion of the ductwork which is buried by insulation to levels meeting requirements for Partially Buried but not to a depth that meets the definition of Fully Buried shall be considered Partially Buried for the purposes of calculating the Effective System R-value. Fully Buried ductwork shall be considered to have a value of **R-13** for fiberglass insulation and **R-15** for cellulose insulation.
   Deeply Buried. The insulation installed over a Deeply Buried duct is such that the top of the duct is at least 3.5" below the surface of the insulation. That portion of the ductwork which is covered completely by insulation, but not to a depth that meets the definition of Deeply Buried, shall be considered Fully Buried for the purposes of calculating the Effective System R-value. Deeply Buried ductwork shall be considered to have a value of **R-25** for fiberglass insulation and **R-31** for cellulose insulation.
   Minimum Clearance to Roof Any portion of the duct where the top of the outer jacket is within six inches of the bottom of the roof sheathing shall be considered unburied for the purposes of calculation.

   Tables displaying effective R-values for typical sizes of flex duct combined with various levels of attic insulation are presented in Attachment #2.

   B. The Effective System R-value shall be calculated for ducts located in attics as follows.
      1. For each individual section of ductwork, the duct area (in square feet) will be divided by the effective duct R-value to obtain an effective UA value for the ductwork. Each individual section of ductwork must be of the same material, must have the same diameter, and must be buried to the same degree.
      2. The effective UA for all sections of ductwork shall be summed resulting in an effective UA value for the entire attic duct system.
      3. The total surface area of the attic ductwork shall be divided by the total, effective UA resulting in the Effective System R-value.

   An example duct design with calculated Effective System R-value is shown in Attachment #3.

C. For performance calculations ACMs shall require both the duct surface area and average R-value be input and used.

4. <u>Construction.</u>

A. A sign must be hung near the attic access reading "Caution: Buried Ducts. Yellow markers indicate location of buried ducts."

B. During construction, vertical indicators must be placed on buried trunk and branch ducts:
   1. At the beginning and end of each duct run,
   2. At each change in burial level,
   3. Where the above requirements do not apply, at a minimum spacing of every eight feet.

C. Vertical indicators must:
   1. Be at least 12" tall,
   2. Adhere to the top, outer jacket of ducts without reducing the vapor impermeability of the jacket,
   3. Be printed with black lettering on a yellow background,
   4. Bear a clear and conspicuous mark at 3½".

5. <u>Verification.</u>

Designs that have claimed an Effective System R-value must be verified by a third party Rater. Verification consists of two portions, design verification and field verification.

A. Design verification.
   1. A rater must review attic duct system plans to see that the designer has clearly indicated those portions of the system that are to be Deeply, Fully, or Partially buried.
   2. A rater must review the duct design summary and calculations of an Effective System R-value.

B. Field Verification.
   1. A rater must inspect the attic duct system before insulation to verify the system is installed according to the design.
   2. A rater must verify that the levels of attic insulation used for calculating the Effective System R-value are installed by the insulation contractor (e.g. Insulation Certificate).
   3. A rater must examine the condition of the Vertical Indicators to check insulation depth and to ensure that the duct locations can be determined in the future.

Blown Fiberglass with R-4.2 Flex Ducts

Insulation Level	Insulation depth (inches)	Maximum Duct Diameter Partially Buried	Fully Buried	Deeply Buried
R-19	7.75	0"	0"	0"
R-30	12	8"	6"	0"
R-38	15.25	13"	9"	6"
R-40	16	14"	10"	7"
R-43	17	15"	11"	8"
R-49	19.75	19"	14"	10"
R-60	24	24"	18"	15"

	Partially Buried	Fully Buried	Deeply Buried
Effective Duct R-value	R-9	R-13	R-25

Effective Duct R-values buried in Blown Fiberglass for Duct Diameter Listed ($ft^2hr°F$ / Btu)

Attic Insulation	4"	5"	6"	7"	8"	10"	12"	14"	16"
R-19	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-30	R-13	R-13	R-13	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-38	R-25	R-25	R-25	R-13	R-13	R-9	R-9	R-4.2	R-4.2
R-40	R-25	R-25	R-25	R-25	R-13	R-13	R-9	R-9	R-4.2
R-43	R-25	R-25	R-25	R-25	R-25	R-13	R-9	R-9	R-4.2
R-49	R-25	R-25	R-25	R-25	R-25	R-25	R-13	R-13	R-9
R-60	R-25	R-25	R-25	R-25	R-25	R-25	R-25	R-25	R-13

Blown Cellulose with R-4.2 Flex Ducts

Insulation Level	Insulation depth (inches)	Maximum Duct Diameter Partially Buried	Fully Buried	Deeply Buried
R-19	5.75	0"	0"	0"
R-30	9	4"	0"	0"
R-38	11.25	7"	5"	0"
R-40	12	8"	6"	0"
R-43	12.5	9"	7"	0"
R-49	14.5	12"	9"	5"
R-60	17.75	16"	12"	8"

	Partially Buried	Fully Buried	Deeply Buried
Effective Duct R-value	R-9	R-15	R-31

Effective Duct R-values buried in Blown Fiberglass for Duct Diameter Listed ($ft^2hr°F$ / Btu)

Attic Insulation	4"	5"	6"	7"	8"	10"	12"	14"	16"
R-19	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-30	R-9	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-38	R-15	R-15	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-40	R-15	R-15	R-15	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-43	R-15	R-15	R-15	R-15	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-49	R-31	R-31	R-15	R-15	R-15	R-9	R-9	R-4.2	R-4.2
R-60	R-31	R-31	R-31	R-31	R-31	R-15	R-15	R-9	R-9

DUCT SIZING WORKSHEET

BUILDER	Munster Builders
PROJECT	MUNSTER Home
PLAN	The "Lilly" (1313 Mockingbird Lane)
METHOD USED	MANUAL D

W/ R-40 Fiberglass

TRUNK	LENGTH	CFM	DUCT SIZE	Surface	R-Value	UA
A	10	336	10	26.2	4.2	6.23
A_1	10	336	10	26.2	13.0	2.01
B	10	328	12	31.4	4.2	7.48
B_1	31	328	12	97.4	9.0	10.82
C	10	320	10	26.2	4.2	6.23
C_1	20	320	10	52.4	13.0	4.03
D	10	432	12	31.4	4.2	7.48
D_1	15	432	12	47.1	9.0	5.24
E/F COMB	10	405	14	36.7	4.2	8.73
E/F_1	37	270	14	135.6	9.0	15.07
F	12	270	12	37.7	9.0	4.19

RUN OUT	LENGTH	CFM	DUCT SIZE	Surface	R-Value	
G	8	19	4	8.4	4.2	1.99
G_1	4	19	4	4.2	25.0	0.17
H	8	160	7	14.7	4.2	3.49
H_1	17	160	7	31.2	25.0	1.25

BRANCH	LENGTH	CFM	DUCT SIZE	Surface	R-Value	
I	5	136	7	9.2	25.0	0.37
J	20	200	8	41.9	13.0	3.22
K	10	164	7	18.3	25.0	0.73
L	10	164	7	18.3	25.0	0.73
M	7	164	7	12.8	25.0	0.51
N	7	156	7	12.8	25.0	0.51
O	10	216	8	20.9	13.0	1.61
P	8	216	8	16.8	13.0	1.29
Q	30	135	8	62.8	13.0	4.83
R	10	135	8	20.9	13.0	1.61
S	22	135	8	46.1	13.0	3.54

RETURN	LENGTH	CFM	DUCT SIZE	Surface	R-Value	
T	17	2000	20	89.0	8	11.13

Plenum (in inches)	Depth	Height	Width	Surface	R-Value	
Supply	48	24	24	36.0	4.2	8.57
Return	24	30	24	23.0	4.2	5.48

Total Area:	1035.6 ft^2
Total UA:	128.6 Btu/°F
Average R:	8.06 $hr°F\text{-}ft^2/Btu$